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POWDERED ACTIVATED CARBON TREATMENT OF BOG SEEP WATER AT ROCKY MOUNTAIN ARSENAL, COLORADO, FINAL REPORT, A PILOT SCALE STUDY

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13. ABSTRACT *(Maximum 200 words)*

A FIELD STUDY WAS CONDUCTED BY THE SANITARY SCIENCES DIVISION, ENERGY AND WATER RESOURCES LABORATORY, MERADCOM, AT RMA TO DEMONSTRATE THE PILOT-SCALE APPLICATION OF THE CARBON/POLYMER PROCESS IN REMOVING THE CONTAMINANTS, DIMP AND DCPD, FROM BOG SEEP WATER. EMPLOYING THE U.S. ARMY 420-GP CARBON/POLYMER UNIT, THE RESULTS INDICATE THE PROCESS CAN EFFECTIVELY REMOVE THE TWO CONTAMINANTS TO UNDETECTABLE VALUES. HOWEVER, THE OPTIMUM CARBON DOSAGE CANNOT BE PREDICTED FROM THE AVAILABLE DATA ALTHOUGH LOWER DOSAGES (BELOW 1,000 MILLIGRAMS PER LITER CARBON) ARE DEFINITELY ATTAINABLE.

14. SUBJECT TERMS
LABORATORY ANALYSIS, REVERSE OSMOSIS DATA, PESTICIDE CONCENTRATION, CONTAMINANT REMOVAL

15. NUMBER OF PAGES

16. PRICE CODE

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DEPARTMENT OF THE ARMY
HEADQUARTERS ROCKY MOUNTAIN ARSENAL
DENVER COLORADO 80240

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SARRM-IR

24 Feb 77

SUBJECT: Final Report -- Powdered Activated Carbon Treatment of Bog Seep Water at RMA

Project Manager for Chemical Demil
and Installation Restoration
ATTN: DRCPM-DRR
Aberdeen Proving Ground, Maryland 21010

Inclosed for your information is the final report on the pilot-scale study of Powdered Activated Carbon Treatment of Bog Seep Water at RMA, prepared by A. Roger Anzzolin, U. S. Army Mobility Equipment Research and Development Center.

FOR THE COMMANDER:

Irwin M. Glassman

1 Incl
as

IRWIN M. GLASSMAN
Director of IR

(Herculfoc 836.2, Hercules Inc., Wilmington, Del.) was added supplementally to the downcomer of the clarifier in a concentration of 3ppm. The diatamaceous earth (Dicalite 4200, Dicalite Division, Grefco Inc., Los Angeles, Ca.) - used as body feed and precoat for the pressure filter - is added to the filter at a rate of 0.05 pound per hour from a two gallon slurry feeder located on the clarifier. The filter pressure was allowed to increase to about 50 pounds per square inch (psig) before the backwash cycle was started. A pressure gage installed on the pressure vessel indicated the pressure build-up. The influent flow was gradually increased to 7 gallons per minute so an upset of the carbon bed would not occur.

This study began March 8 with the initial set-up of equipment, and was to run for a minumum of six months. However, manpower problems and loss of operator personnel at the Arsenal caused a substantial time loss in evaluating various carbon dosages as outlined in the original proposal. Furthermore, with the appointment of an engineer from Rocky Mountain Arsenal to manage the treatment study, a redirection of effort was initiated to obtain adsorption data on the carbon/polymer process using the 420-gph ERDLator. This redirection placed MERADCOM in a consulting position. Data gathered in this change of effort is under separate cover.[1]

IV. RESULTS

During the time period of the field study (8 March - 20 May) the carbon/polymer process demonstrated its applicability towards removing the contaminant DIMP from the Arsenal bog water from Section 24. Per cent removal of DIMP from the bog water was consistently above 99 per cent for both carbon dosages of 1,649 and 1,000 milligrams per liter. Because

[1] Interim Report 420 gph Pilot Plant Powered Carbon Dosage Study, January 1977? No Author Listed.

the study was redirected, the optimum carbon dosage was not established.

V. DISCUSSION

Initial DIMP concentrations during the course of this study ranged from a high of 470 parts per billion (ppb) to a low of 210 parts per billion. The highest concentrations occurred when 1,000 mg/l carbon were used. All DIMP values were greater than 200 parts per billion. See Figure 8. Final DIMP concentrations after treatment are shown on the bottom of Figure 8. Sixty per cent of all values were below detectable limits. Ninety-four per cent were lower than two parts per billion.

As the primary objective of the treatment study was to determine if the carbon/polymer process could sucessfully remove the DIMP (and DCPD) concentrations, the percentage of DIMP removal positively demonstrated the effectiveness of this process. Figure 9 shows that the removal of DIMP for both carbon dosages is consistently greater than 99 per cent. Only further effort could develop per cent removal for lower dosages of carbon. In this study no inference can be made, for example, for final DIMP concentration to be ten parts per billion, nor the amount of carbon necessary for only eighty per cent removal of DIMP.

Since most values of the final DIMP concentration were below 0.5 parts per billion (undetectable), it was difficult to present the removal of contaminant (DIMP) per unit weight of carbon (adsorbent). No true adsorption isotherm can be drawn from the data, since no actual value for C, impurity remaining, can be assigned to the X/M value--impurity removed per unit of carbon. Therefore, Figures 10 and 11 show the removal of DIMP per pound of carbon against volume of wastewater treated for

1,649 and 1,000 milligrams per liter, respectively. The upper plots show the amount of DIMP removed (in ppb) as it relates to the X/M value.

Because the DCPD compound is very volatile, the compound was never detected in the feed or product of the carbon/polymer process. This volatization occurred most probably when the feed water was transferred from the tank to the source tanks.

As expected, the carbon/polymer process did not alter the conductivity, total dissolved solids (TDS), or the pH of the bog water during treatment. However, the chemical oxygen demand (COD) was reduced for both carbon dosages. See Figure 12.

As we mentioned previously, the reverse osmosis system (RO) study was discontinued because the carbon/polymer process reduces the problem contaminants below detectable limits. Nevertheless, limited data was collected on conductivity, COD, and DIMP concentrations for the RO systems. A study of Table 6 shows the concentrations that occurred in those three parameters during operation of the RO system.

VI. Conclusions

Based on the data obtained, this report concludes that:

a. The carbon/polymer process (ERDLator) can effectively remove the two contaminants - DIMP and DCPD - from the bog water located in Section 24 at Rocky Mountain Arsenal.

b. Carbon dosages of 1,649 and 1,000 milligrams per liter decreased the DIMP concentration to below detectable limits.

c. The limited amount of data available from this study cannot be used to predict the optimum carbon dosage because the final DIMP concentrations were almost entirely below detectable limits. However, lower dosages are definitely attainable.

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1. Decontamination of Water Containing Biological Warfare Agents, USAMERADCOM Report 2131, February 1975, Don C. Lindsten and Richard P. Schmitt, authors.

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3. Treatment of Wastewaters From Military Field Laundry, Shower, and Kitchen Units, USAMERADCOM Report 2061, May 1973, by Daniel S. Lent and Robert G. Ross.

4. 1974-75 Groundwater Study of the Rocky Mountain Arsenal and Some Surrounding Area, no date, Prepared by: Colorado Department of Health, Water Quality Control Division, Robert J. Shukle, Industrial Waste Consultant.

5. Treatability Studies of Seep Water from the Bog at Rocky Mountain Arsenal, December 1975, by R.P. Carnahan, D. Lent, R. Anzzolin, and G. Rutherford.

6. A Proposal for Field Studies Conducted at Rocky Mountain Arsenal, Colorado, January 1976, by Roger Anzzolin.

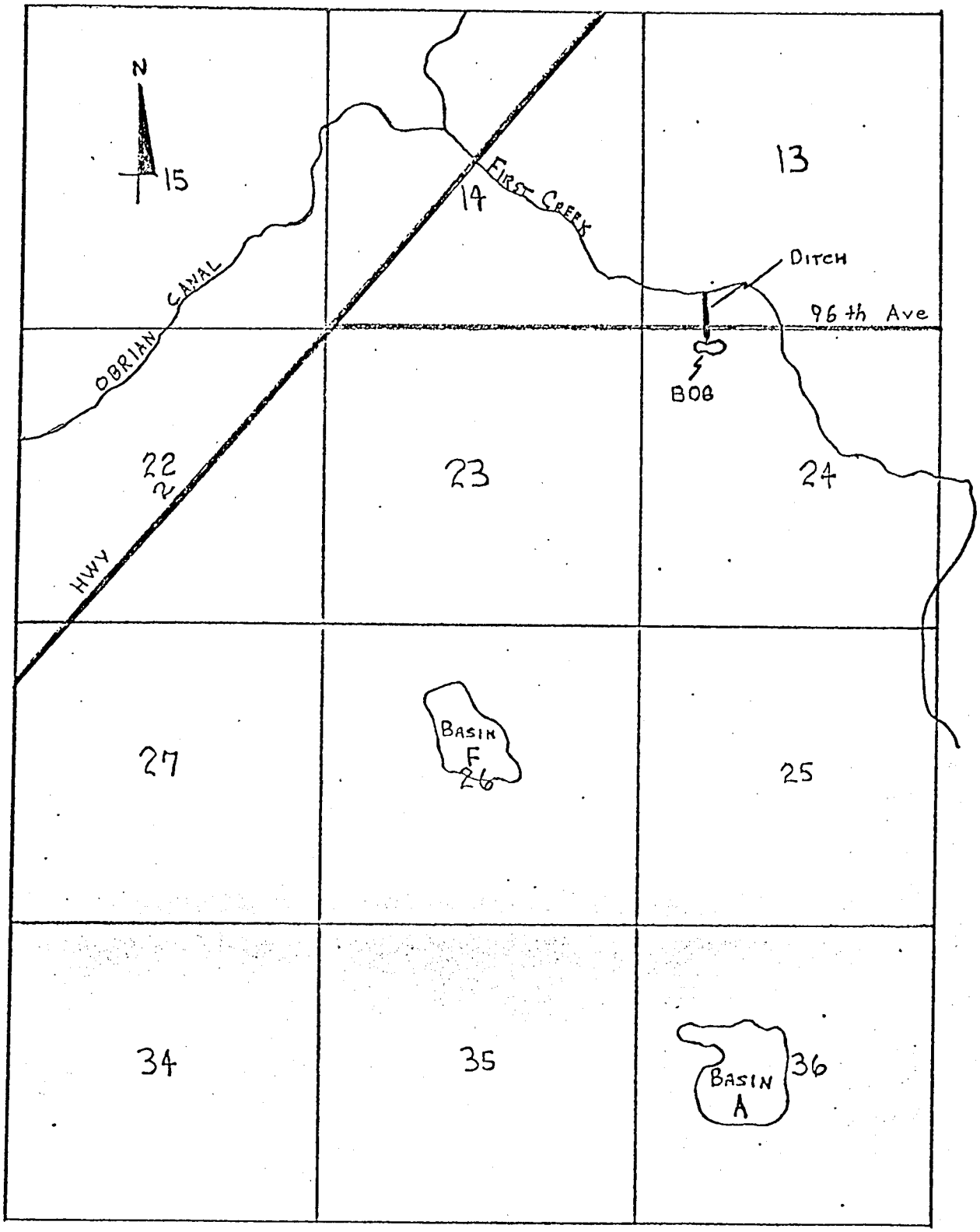

Figure 1. Generalized Map of Rocky Mountain Arsenal
Denver, Colo.

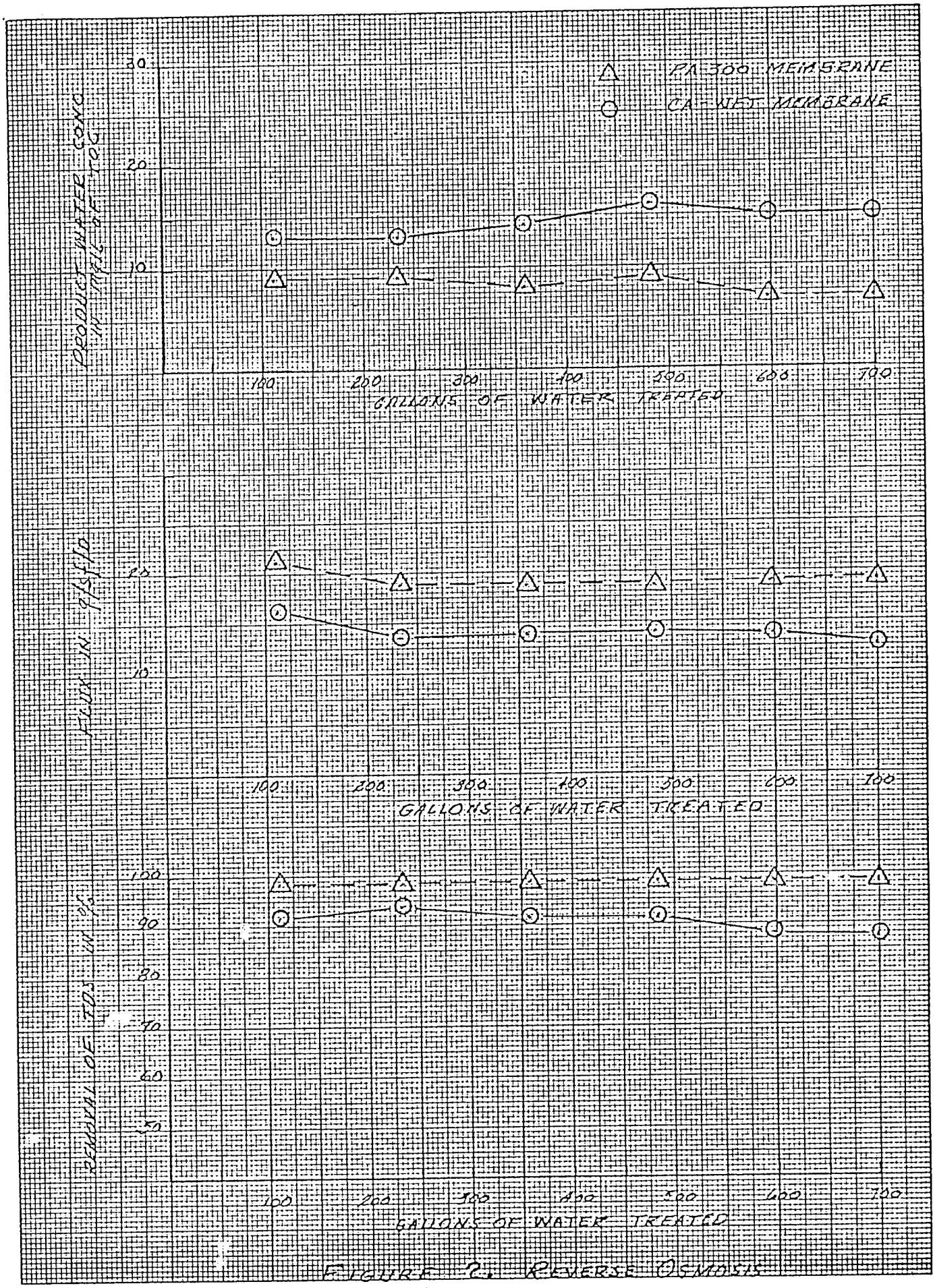

FIGURE 2. REVERSE OSMOSIS

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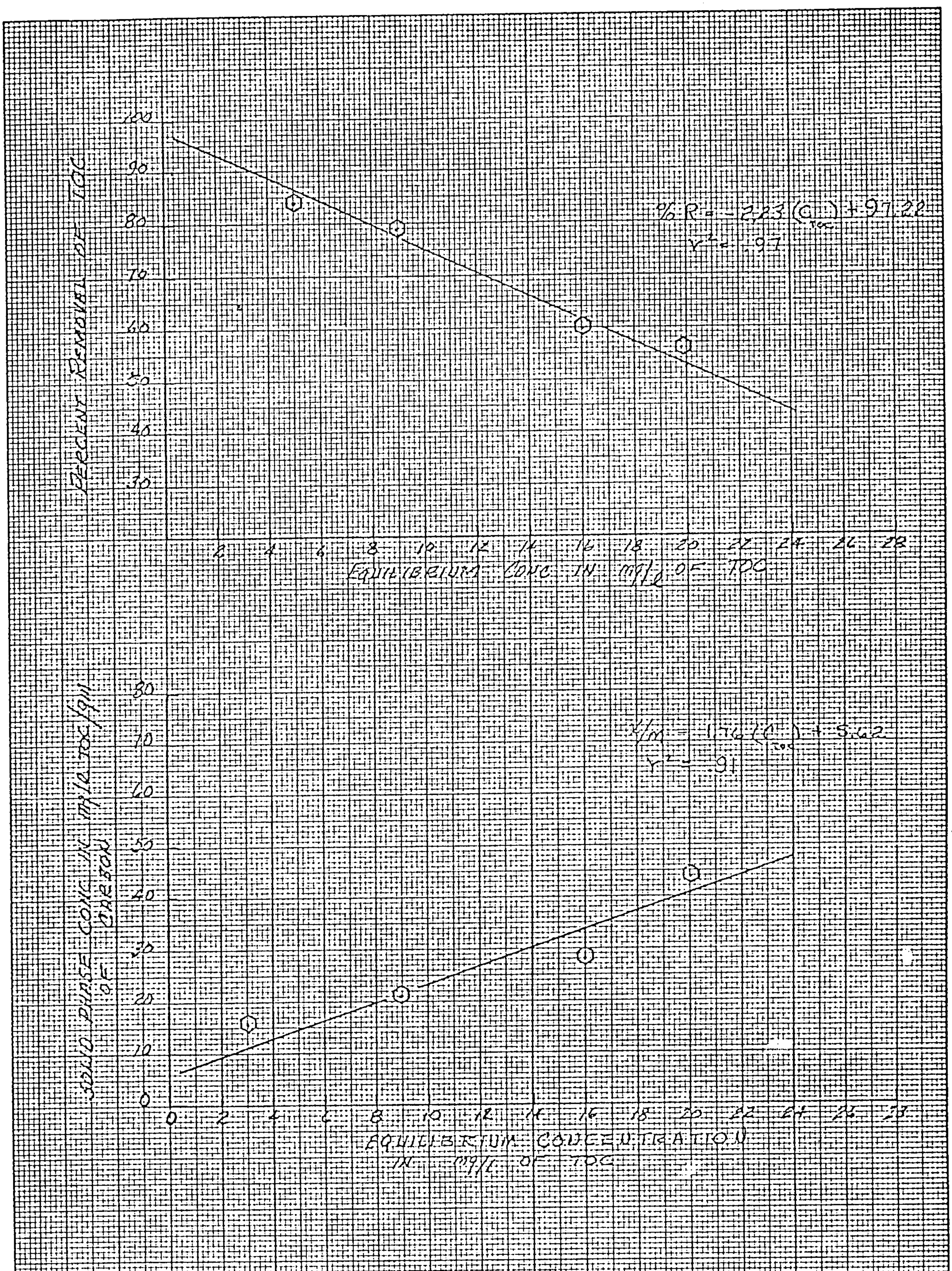

FIGURE 3. DARCO G-60 CARBON

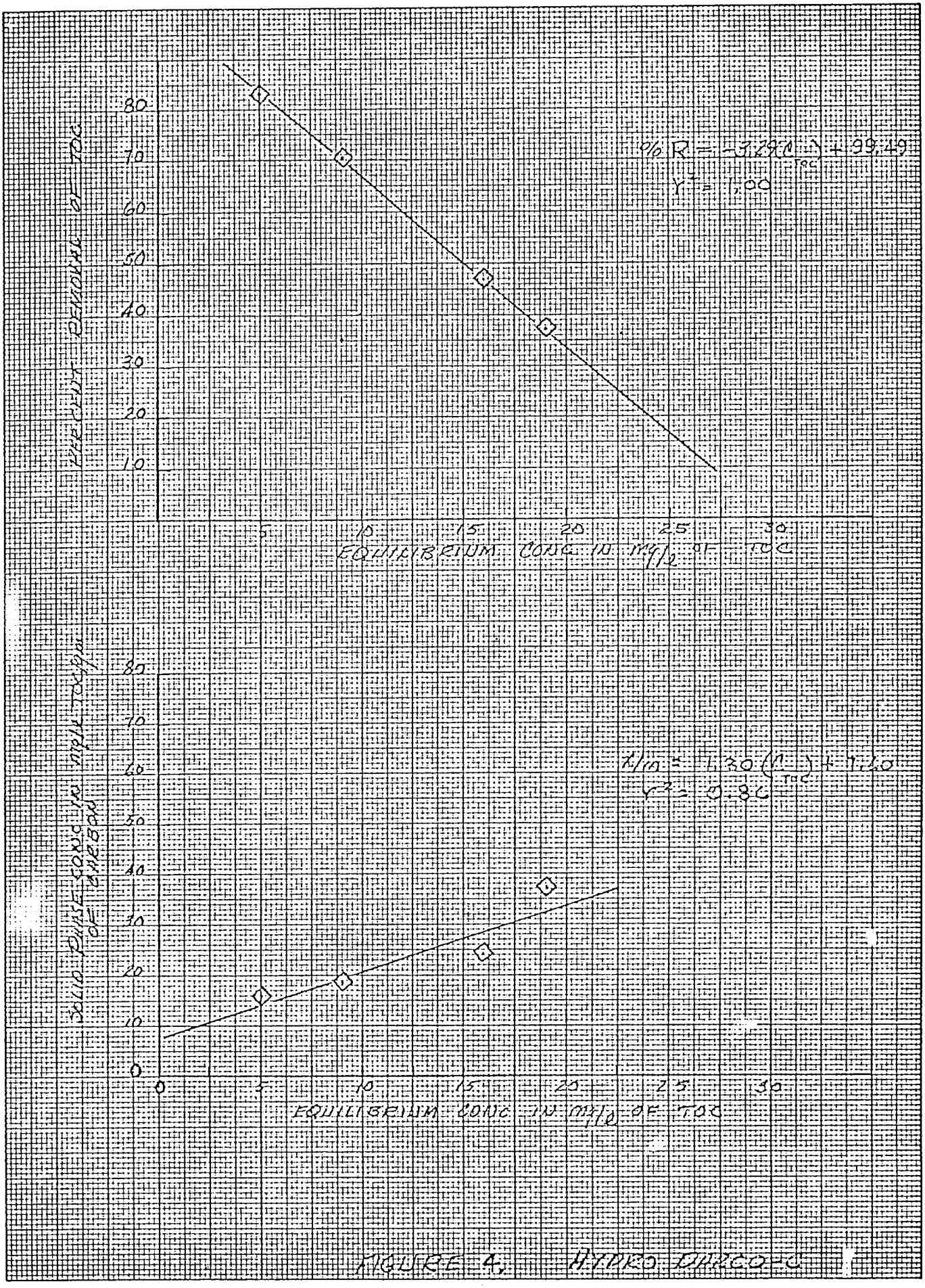

FIGURE 4. HYPO ORCO-C

WASTEWATER RECLAMATION UNIT, 420 GPH

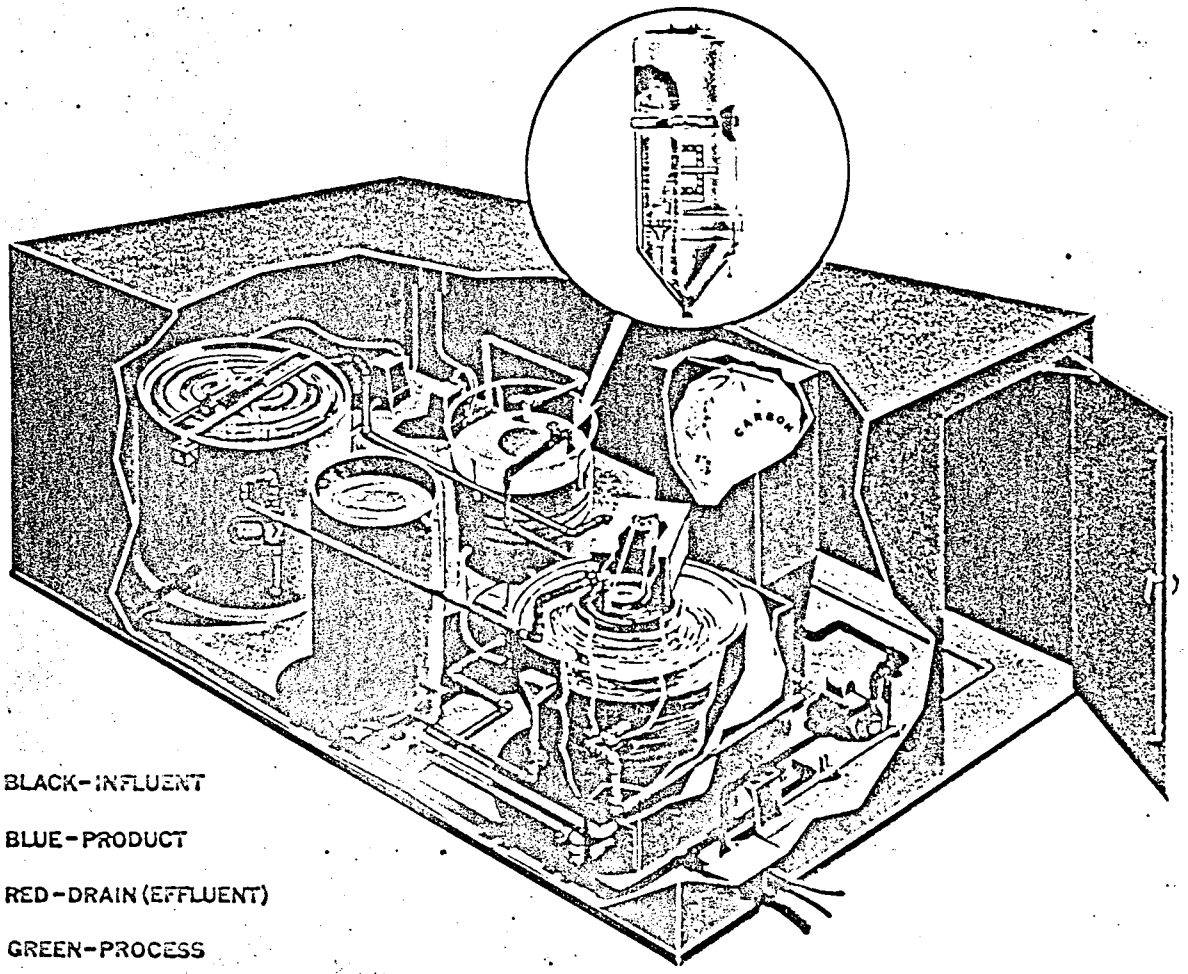

Figure 5. Carbon/Polymer System

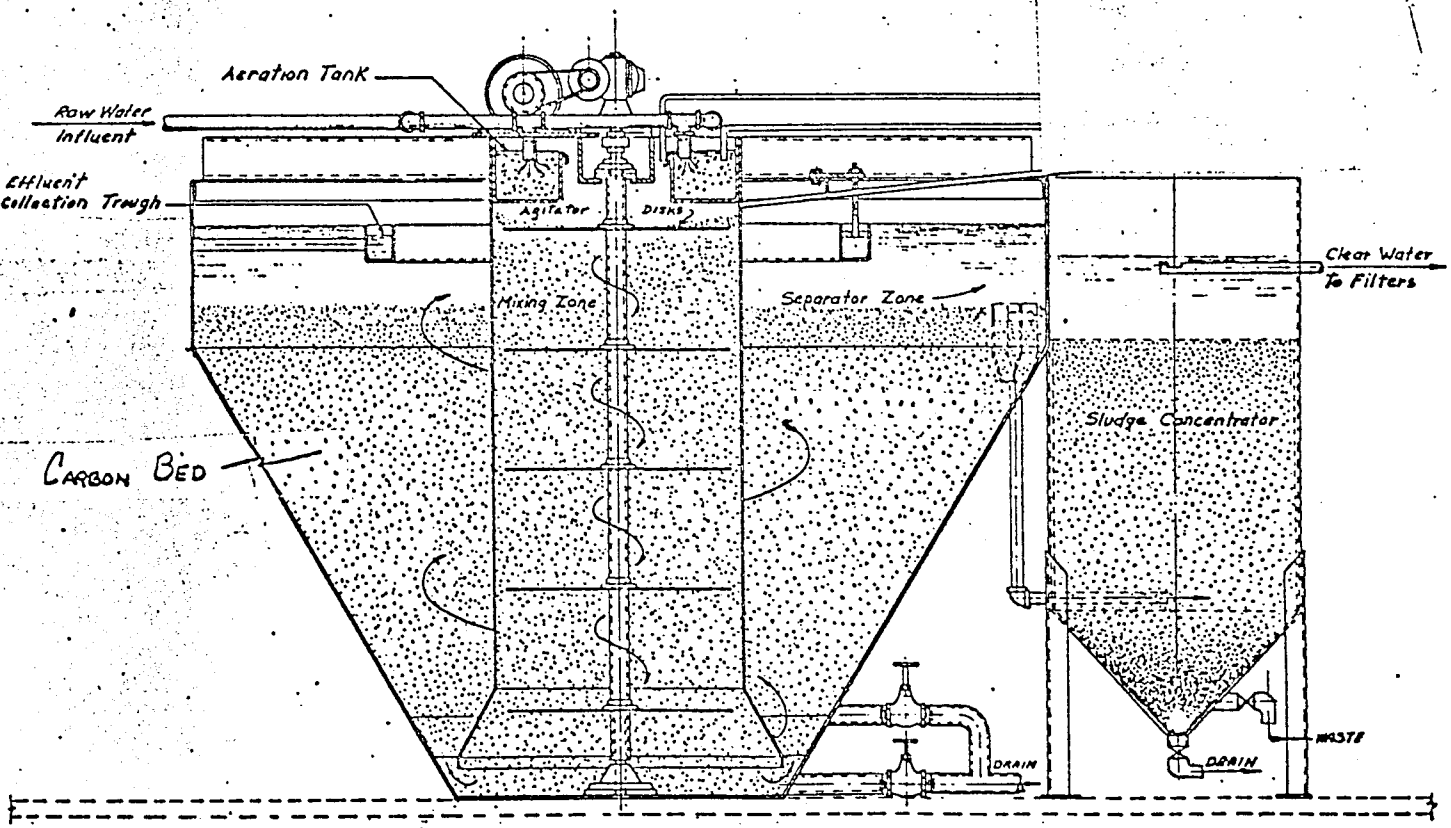

Figure 6. Diagram of ERDLator-type, solids-contact basin.

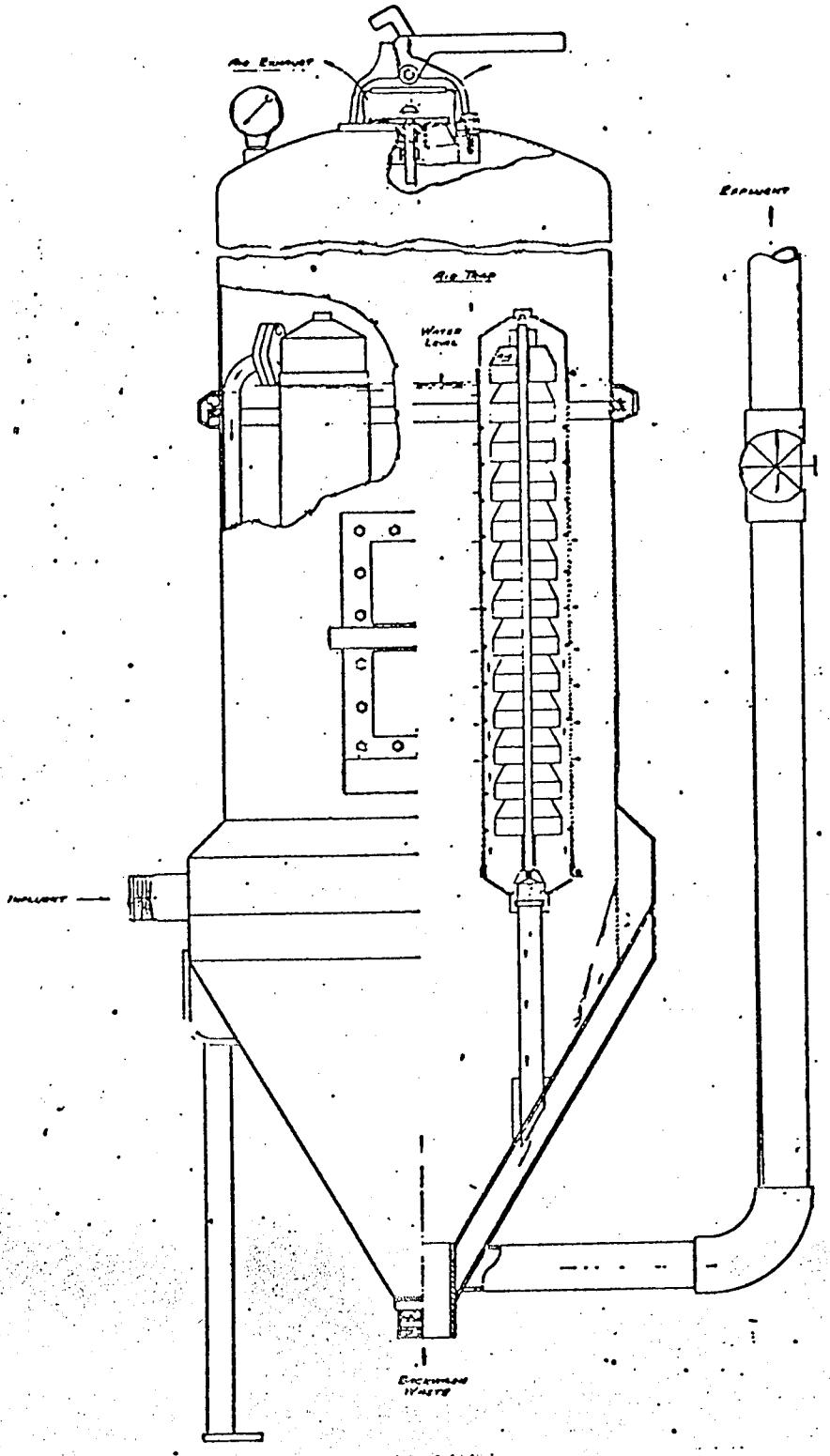

Figure 7. Pressure diatomite filter.

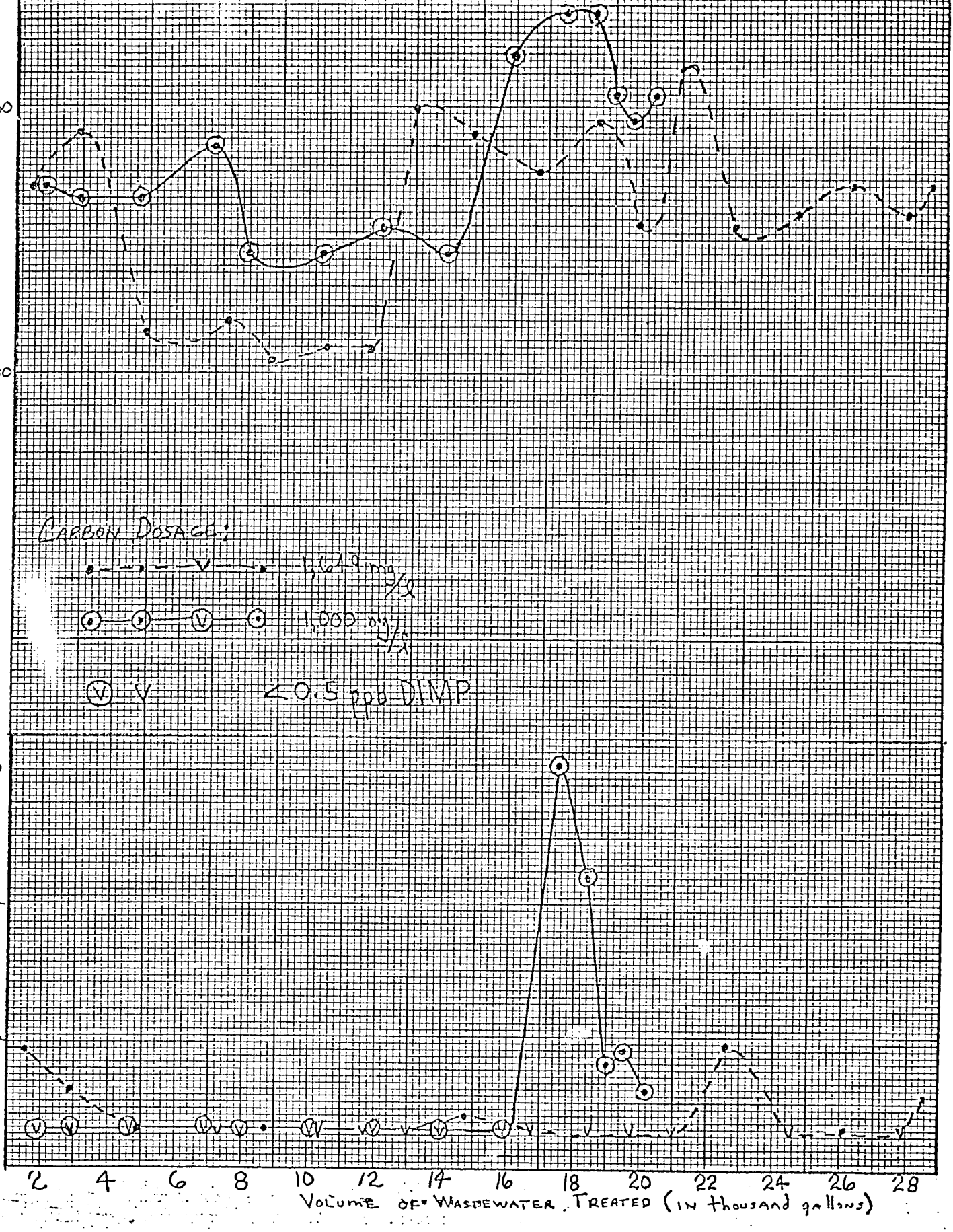

Figure 8. DIMP Concentration

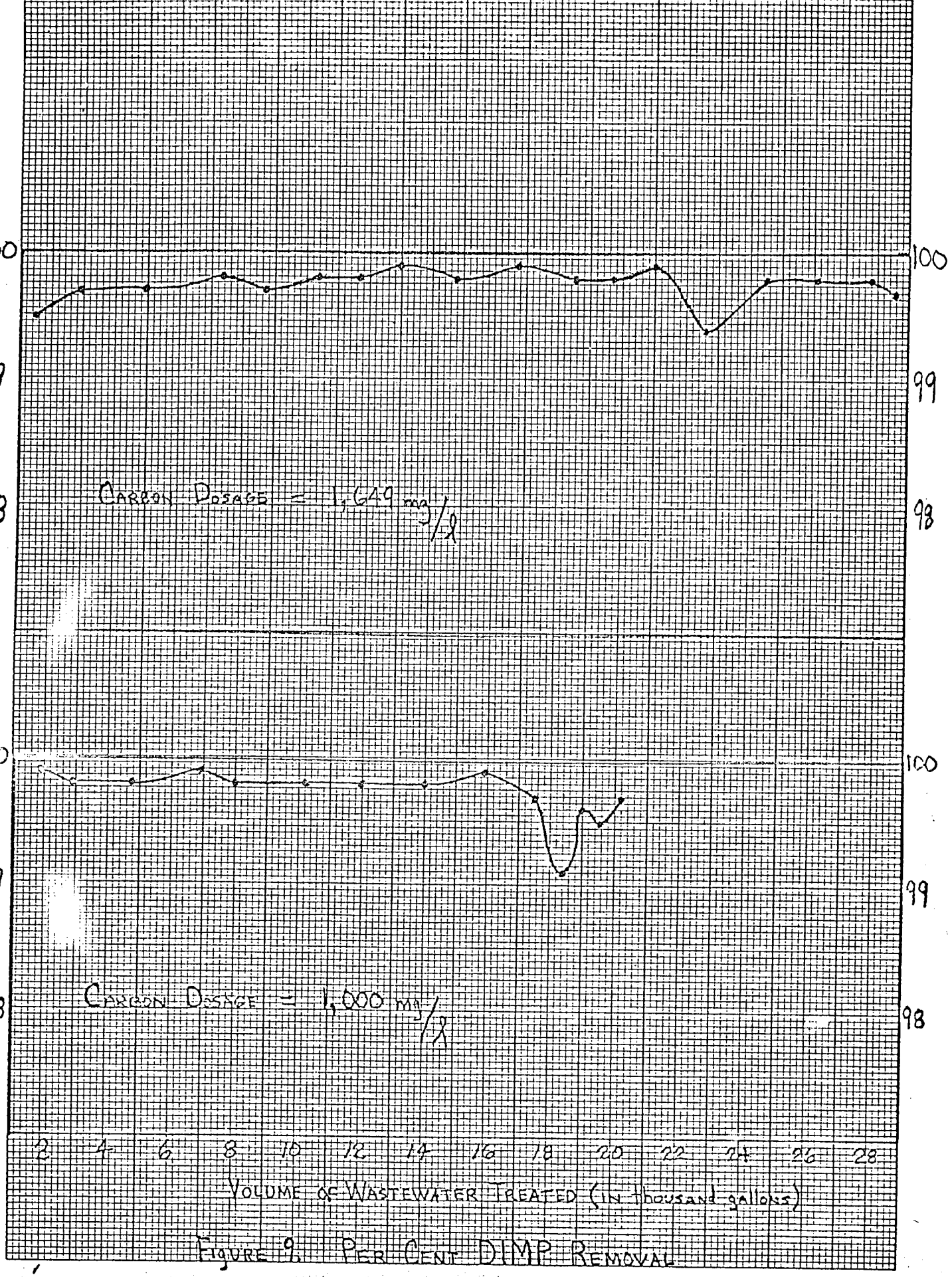

Figure 9. Per Cent DIMP Removal

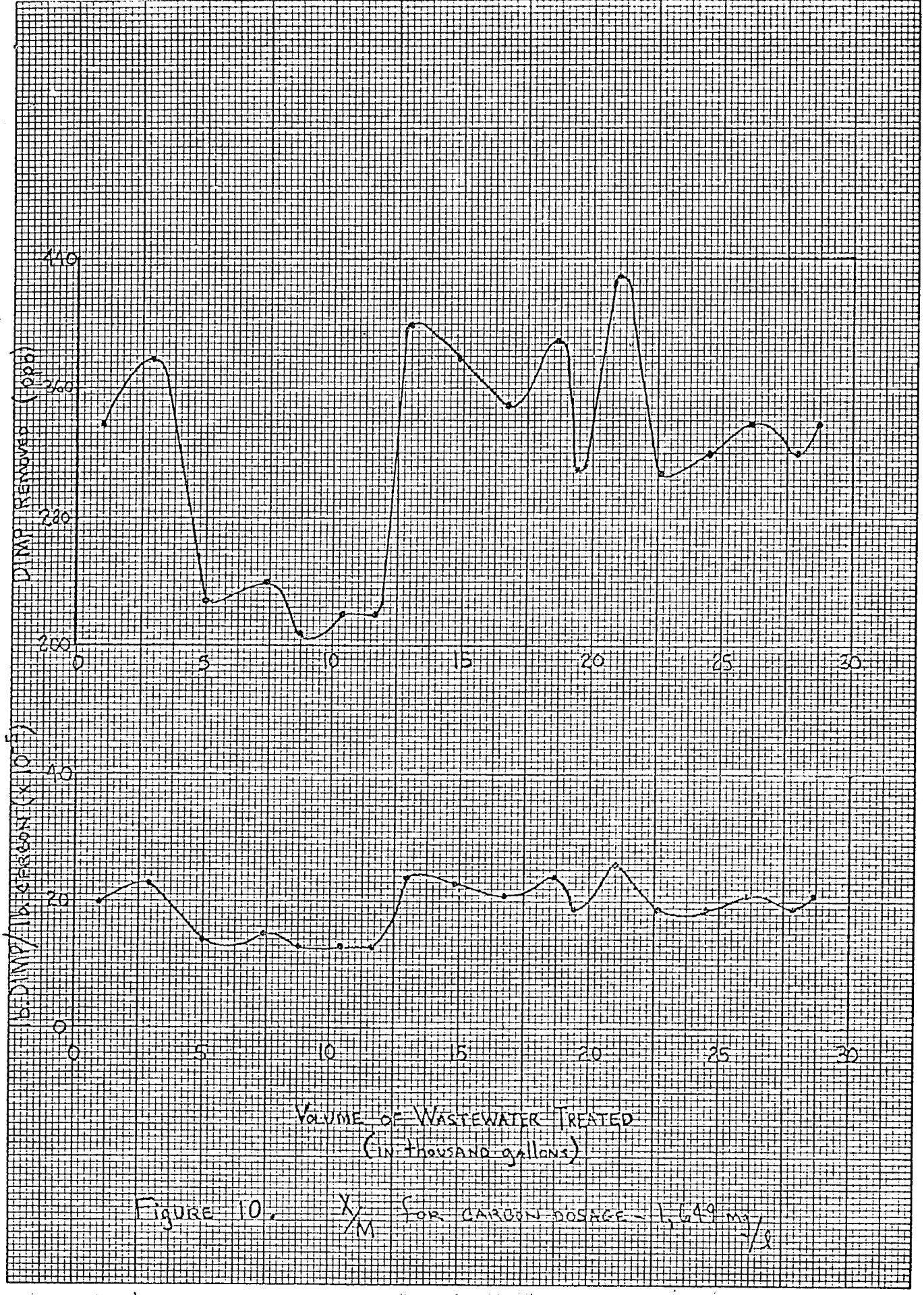

FIGURE 10. X/M FOR CARBON DOSAGE = 1,649 mg/l

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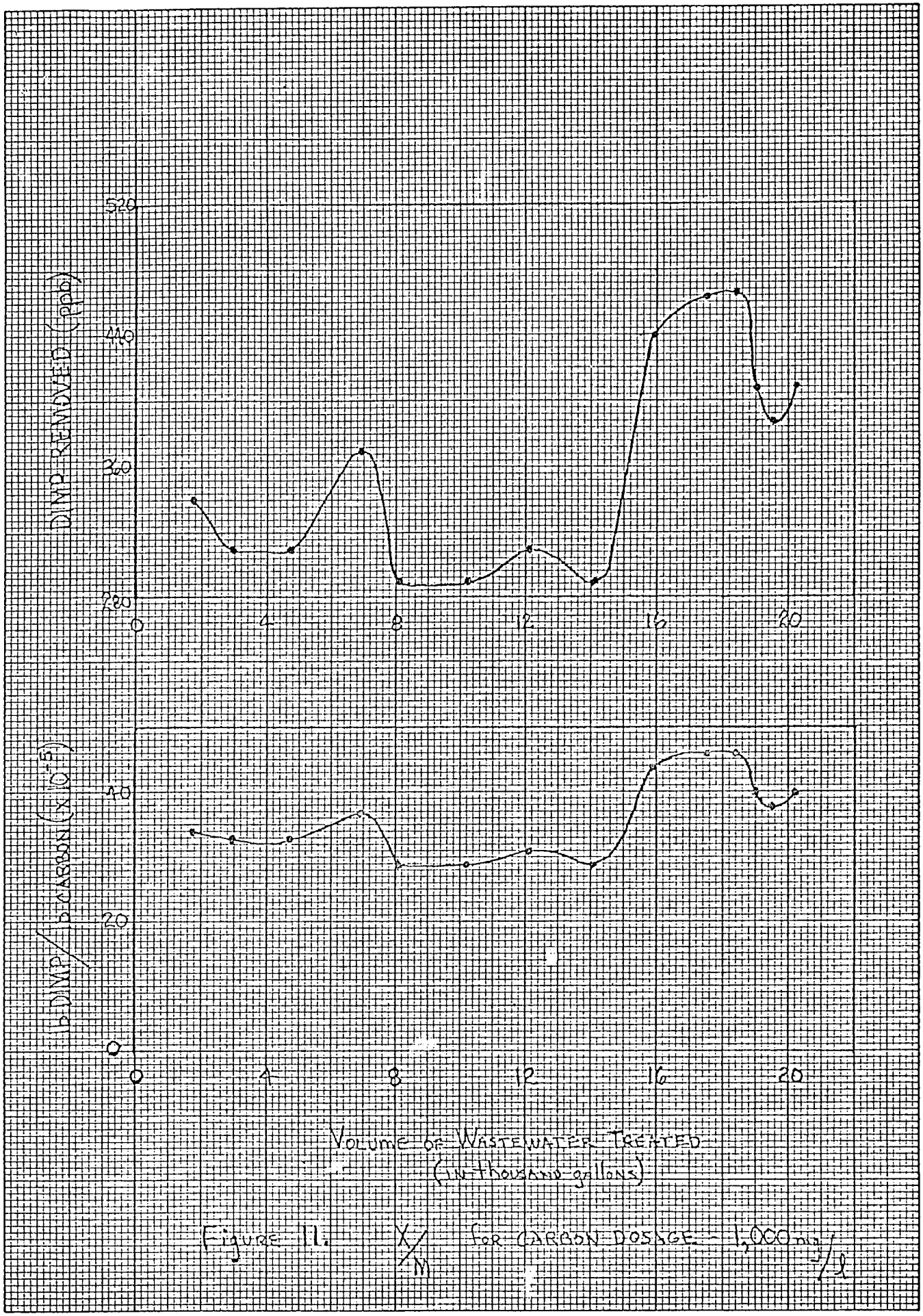

Figure 11. $\frac{X}{M}$ for CARBON DOSAGE = 1,000 mg/l

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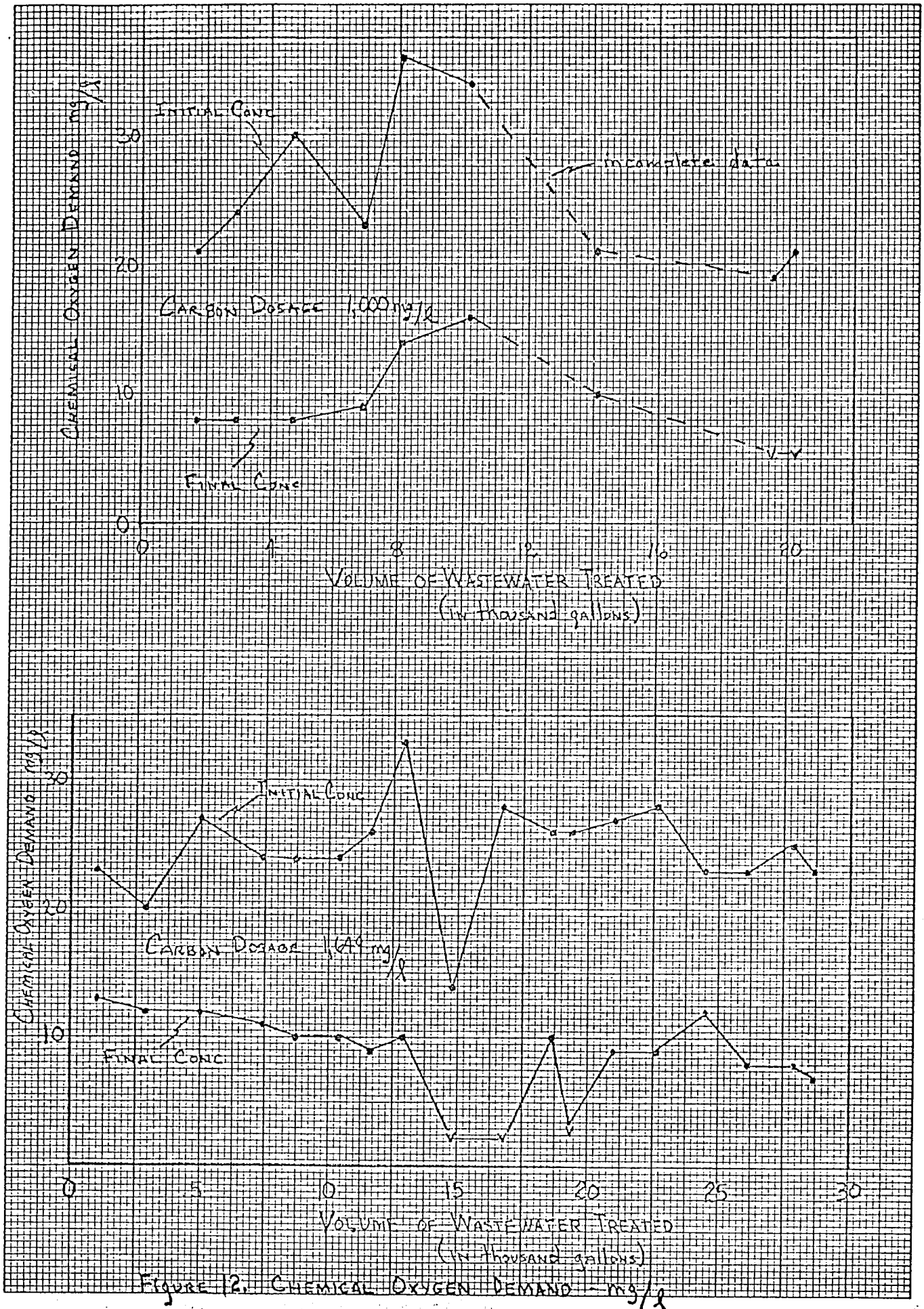

Figure 12. Chemical Oxygen Demand - mg/l

TABLE 1

RESULTS OF ANALYSES OF UNTREATED SEEP WATER

Analysis		9/12/75	9/23/75	10/24/75
Turbidity	units	3.0	1.0 unit	1.3 units
Color	units	19	18	18
Total Dissolved Solids	mg/l	1300	1350	1300
Conductivity	micromhos/cm	1850	1850	1825
pH		7.6	7.9	8.0
Alkalinity	mg/l	252	256	240
Hardness	"	488	498	466
Chlorides	"	232	239	286
Sulfates	"	627	540	620
Nitrates	"	1.5	-	-
Copper	"	0.0	0.0	
Chromium	"	0.0	0.0	
Cadmium	"	0.01	0.02	
Iron	"	0.40	0.46	
Total Organic Carbon	"	38	41	39
COD	"	31	36	40
BOD	"	<1.	<1.	

TABLE 2

PESTICIDE CONCENTRATION IN WATER

Pesticide	State Health Dept	Rocky Mt Arsenal	Shell Chemical	US Army Environmental Hygiene Agency
Aldrin	0	-	0	1.4
Dieldrin	-	-	0.6	0.5
Dicycoopenta Diene	<50	-	15	
Diisopropyl Methalphosph	0	268	340	
Endrin	1.04	-	0	2.1

Concentration in parts per billion (ppb).

TABLE 3

Powdered Carbon with Coagulant	Cationic Polyelectrolyte*					
	DARCO G-60			HYDRO DARCO-C		
Catfloc Dose mg/l	Final TOC mg/l	Capacity mg/l TOC/ 9g ADS	% Removal	Final TOC	Capacity mg/l TOC/ 9g ADS	% Removal
5	25	3.0	10.7	21	7.0	25.0
10	16	12.0	42.9	20	8.0	28.6
20	11	17.0	60.7	24	4.0	14.3
30	15	13.0	47.4	19	9.0	32.1
40	18	10.0	35.7	19	9.0	32.1
50	11	17.0	60.7	14	14.0	50.0

*Initial conditions were - 1 gram of powder carbon per liter;
TOC concentration 28 mg/l at pH=7.4

TABLE 4

POWDERED CARBON WITH ANIONIC * COAGULATION

Drewfloc Dose mg/1	Hydro Darco-C		
	Final TOC mg/1	Capacity mg/1 TOC/gram adsorbent	% Removal
0.2	23	7.	23.
0.5	8	22.0	73.
0.5	15	15.0	50
5.0	11	19.0	63
8.0	11	19.0	63
10.0	12.5	17.5	58
10.0	19	11.0	37
15.0	28	2.0	7
20	26	4.0	13

* Initial Conditions 1 gram Carbon

Initial Concentration 30 mg/1 TOC

TABLE 5

LABORATORY ANALYSES

QUALITY ASSURANCE LAB

1. Daily Analyses - To be performed on raw and feed water.
   a. COD - Chemical Oxygen Demand
   b. pH
   c. Conductivity
   d. DIMP/DCPD

Note: Use Composite Sample

2. Weekly Analyses - To be performed on raw and feed water.
   a. Chloride
   b. Sulfates
   c. Nitrates
   d. Copper
   e. Chromium
   f. Cadmium
   g. Iron
   h. Alkalinity

ON SITE OPERATOR

1. Hourly Analyses
   a. pH
   b. TDS - Total Dissolved Solids
   c. Turbidity
2. Hourly Operational Measurements
   a. Filter Runs (Pressure on Filter)
   b. Feed Rates
   c. Effluent Rate

TABLE 6 REVERSE OSMOSIS (RO) DATA

DATE	Conductivity umhos/cm			Chemical Oxygen Demand - mg/l			DIMP Concentration - ppb		
	ERDLator Product	RO Product	RO Brine	ERDLator Product	RO Product	RO Brine	ERDLator Product	RO Product	RO Brine
4/6	1,820	330	5,900	9	< 2	44	< 0.5	<0.5	2.3
4/7	1,670	460	9,400	10	<2	40	< 0.5	< 0.5	2.8
4/9	1,820	540	5,600	< 2	<2	26	0.8	< 0.5	1.9
4/12	1,850	1,470	4,550	< 2	<2	16	<0.5	< 0.5	1.0
4/15	1,780	220	1,110	9	<5	190	< 0.5	1.3	1.7
4/19	1,850	290	9,800	9	<5	140	1.9	<0.5	2.6
4/20	1,850	410	9,100	12	<5	130	<0.5	<0.5	1.0
4/22	1,790	590	10,000	8	<5	130	<0.5	<0.5	1.1
4/26	1,840	380	7,100	8	<5	75	<0.5	<0.5	1.5
4/27	1,780	460	6,670	8	<5	100	<0.5	<0.5	1.6
5/18	1,720	680	3,450	< 5	<5	21	1.2	1.0	1.3